

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1 to 36 (Cancelled).

37. (Withdrawn) A leak detector comprising:

at least one actuator controlled by a controller, said at least one actuator being configured to control pressure in a blood circuit, said controller configured to control flow in said blood circuit and detect a loss of integrity in said blood circuit by:

delivering blood to a patient through the blood circuit during first time including applying a positive gauge pressure to said circuit;

applying a negative pressure to said blood circuit during second time;

detecting a presence of air in said blood circuit during at least a portion of said second time or after said second times, such that air infiltrating said blood circuit during said second time as a result of said negative pressure and a presence of a leak is detected.

38. (Withdrawn) A detector as in claim 37, wherein said controller is further configured to wait passage of a predetermined volume of blood into said patient .

39. (Withdrawn) A detector as in claim 37, wherein said controller is further configured such that said applying a negative pressure includes reversing a direction of flow of blood in said blood circuit.

40. (Cancelled).

41. (Withdrawn) A detector as in claim 37, wherein said controller is further configured such that said detecting includes detecting air bubbles in blood.

42. (Withdrawn) A detector as in claim 37, wherein said controller is further configured such that:

said applying includes reversing a direction of flow of blood in said blood circuit;

said detecting includes detecting air with an air sensor located to detect air at a specified position in said blood circuit; and

a duration of said second time is at least long enough to insure that blood will ultimately flow from said blood circuit to said specified position, whereby detection of a leakage of blood in said blood circuit at said specified position is assured.

43. (Withdrawn) A leak detector connectable to a blood processing machine that has an access blood circuit connectable to a patient to remove blood from, and deliver blood to, said patient; a process blood circuit including a treatment component for treating blood circulated through said process blood circuit, said leak detector comprising:

a reversible conveyance connected to move blood through said process and access blood circuits;

an air detector in said access circuit;

a controller configured to reverse said conveyance periodically to draw air into any leaks in said blood circuit and to control said conveyance such that said air is moved to said air detector, whereby a leak in said access blood circuit may be detected.

44. (Cancelled).

45. (Withdrawn) A detector as in claim 43, wherein said air detector detects air bubbles in fluid.

46. (Withdrawn) A leak detector connectable to a device operative to control a flow of blood through a blood circuit, said leak detector including a controller programmed to implement a method of detecting a leak in a fluid circuit supplying fluid to a patient, comprising:

delivering fluid to a patient through a circuit during a first time;
applying a negative pressure to said blood circuit during a second time;
detecting a presence of air in said fluid circuit during at least a portion of said second time or after said second time such that air infiltrating said fluid circuit during said second time as a result of said negative pressure is detected.

47. (Withdrawn) A detector as in claim 46, wherein said step of applying a negative pressure includes reversing a direction of flow of fluid in said fluid circuit.

48. (Withdrawn) A detector as in claim 46, wherein said step of detecting includes detecting air bubbles in fluid.

49. (Withdrawn) A detector as in claim 46, wherein:
said step of applying includes reversing a direction of flow of fluid in said fluid circuit;
said step of detecting includes detecting air with an air sensor located to detect air at a specified position in said fluid circuit; and

a duration of said second time is at least long as required to cause said fluid to flow from said fluid circuit to said specified position.

50. (Withdrawn) A leak detector comprising:

a controller configured to detect a leak in a fluid infusion or treatment system that includes a source of fluid to be pumped into a patient;

the controller drawing from said source and conveying said fluid from said source to said patient during a first time and automatically regularly generating a negative pressure such that said fluid is drawn in a reverse direction away from said patient creating a reverse flow of said fluid and detecting one of a presence and a flow of air into said fluid infusion system.

51. (Withdrawn) A detector as in claim 50, further comprising a sensor connected to said controller to detect a presence of air in said reverse flow.

52. (Withdrawn) A detector as in claim 50, wherein said fluid includes blood.

53. (Withdrawn) A detector as in claim 50 wherein said controller is configured to one of generate an alarm signal and halt a flow of fluid responsively to detecting said one of a presence and a flow.

54. (Withdrawn) A detector as in claim 50, wherein said fluid is blood.

55. (Withdrawn) A detector as in claim 50, wherein said controller generates said negative pressure by controlling a flow reversing actuator.

56. (Withdrawn) A detector as in claim 55, wherein said fluid is blood.

57. (Withdrawn) A detector as in claim 50, wherein said source of fluid is said patient's blood supply and said reverse flow is such that blood is drawn from said patient.

58. (Cancelled).

59. (Cancelled).

60. (Cancelled).

61. (Withdrawn) A leak detector for an infusion device for delivering a fluid to a patient, the device including a circuit including a pump, a source end and a delivery end joined by said pump, comprising:

a mechanism to reverse flow at least at said delivery end;

an air detector in said circuit;

said mechanism being controlled such that said mechanism is actuated to reverse said flow automatically and, at each instance of reversing said flow, to displace enough fluid to transport air infiltrating said circuit to said air detector.

62. (Withdrawn) A detector as in claim 61, wherein said mechanism is a drive configured to reverse said pump.

63. (Withdrawn) A leak detector with at least one actuator and a controller programmed to implement a method of detecting a loss of integrity in a liquid circuit, comprising:

conveying liquid through a circuit during first time;

said step of conveying including applying a positive gauge pressure to said circuit; regularly applying a negative pressure to said circuit during second time;

detecting a presence of air in said liquid circuit during at least a portion of said second time or after said second time, such that air infiltrating said circuit during said second time, as a result of said negative pressure and a presence of a leak, is detected.

64. (Withdrawn) A detector as in claim 63, wherein the step of applying a negative pressure includes reversing a direction of flow of liquid in said circuit.

65. (Withdrawn) A detector as in claim 63, wherein said step of detecting includes detecting air bubbles.

66. (Withdrawn) A leak detector for an infusion device that includes a circuit connectable to a patient to deliver fluid to a patient, comprising:

a reversible conveyance connected to move fluid through said circuit;

an air detector in said circuit;

a controller configured to reverse said conveyance regularly and periodically to draw air into any leaks in said circuit and move said air to said air detector, whereby a leak in said circuit may be detected.

67. (Withdrawn) A detector as in claim 66, wherein said air detector detects air bubbles in said fluid.

68. (Withdrawn) A leak detector for a blood processing machine that includes a draw circuit and a return circuit connected, respectively, to supply blood from a patient to, and return blood to said patient from, a blood processing device, comprising:

a reversible conveyance connected in said draw and return circuits to drive blood therethrough;

a controller connected to control said reversible conveyance such that said reversible conveyance is reversed;

at least one air sensor in said circuit;

said controller being configured such that a volume of blood displaced in reverse each time said reversible conveyance is reversed is sufficient to insure blood in said return circuit is drawn at least to said at least one air sensor.

69. (Withdrawn) A leak detector as in claim 68, wherein said air sensor detects bubbles in blood.

70. (Withdrawn) A leak detector as in claim 68, wherein said reversible conveyance includes a reversible pump.

71. (Withdrawn) A device for detecting leaks and connectable to a blood processing system having an air sensor adapted to detect blood in a blood circuit, said blood circuit having draw and return lines:

a conduit connectable to said return line;

a fluid conveyance connectable to said return line and said conduit and configured to connect said return line to a patient return access;

said conveyance being adapted to selectively and generate a reverse flow in said conduit and convey said reverse flow to said draw line;

a final control configured to control said conveyance to generate said reverse flow repeatedly during a treatment cycle of said blood processing leak detector.

72. (Withdrawn) A leak detector for a blood processing machine that includes an access blood circuit connectable to a patient to remove blood from, and deliver blood to, said patient and a process blood circuit including a treatment component adapted to treat blood circulated through said process blood circuit, comprising:

a conveyance connected to move blood through said process and access blood circuits configured to generate a negative pressure in a return portion of said access blood circuit;

an detector configured to detect infiltration of air in said return portion;

a controller configured to generate said negative pressure in said conveyance repeatedly during a treatment cycle to draw air into said access circuit.

73. (Cancelled).

74. (Withdrawn) A method of detecting a loss of integrity in a blood circuit supplying blood to a patient, comprising the steps of: delivering blood to a patient through a circuit during first times; said step of delivering including applying a positive gauge pressure to said circuit; applying a negative pressure to said blood circuit during second times; detecting a presence of air in said blood circuit during at least a portion of said second times, such that air infiltrating said blood circuit during said second times as a result of said negative pressure and a presence of a leak is detected.

75. (Withdrawn) A method as in claim 74, wherein the step of applying a negative pressure includes reversing a direction of flow of blood in said blood circuit.

76. (Withdrawn) A method as in claim 74, wherein said step of detecting includes detecting air bubbles in blood.

77. (Withdrawn) A leak detection device connectable to a fluid infusion or treatment system, comprising: a support for a fluid circuit configured to convey fluid between a source and an outlet for connection to a patient; at least an actuator operative to control a portion of said fluid circuit such that a negative pressure can be selectively generated in an outlet portion of said fluid circuit at selected times; a controller connected to control said actuator and configured to generate a negative pressure in said outlet portion automatically and repeatedly during the course of a treatment of said patient such that a volume of fluid is displaced in a reverse direction; said controller being further configured to control said actuator such that, at other times, a positive pressure is permitted in said outlet portion.

78. (Withdrawn) A device as in claim 77 wherein said fluid is blood.

79. (Withdrawn) A device as in claim 77 wherein said fluid is blood.

80. (Withdrawn) A device as in claim 77, further comprising an air sensor positioned to detect air in said fluid circuit when said fluid flows in reverse responsively to said controller.

81. (Withdrawn) A replacement kit for infusing a patient, comprising: a blood line including: a draw line connectable to at least one patient blood access; a return line connectable to said at least one patient blood access; a portion adapted to be interoperable with a pump actuator such that fluid may be conveyed therethrough; a filter to complete a

closed fluid circuit joining said draw and return lines; and said kit adapted to be interoperable with a pump actuator into a location such that the kit becomes interoperable with a reversible pump.

82. (Previously Presented) A leak detector for a sterile contiguous fluid line for infusing a patient, the fluid line including a draw line connectable to at least one patient access and a return line connectable to said at least one patient access, said detector comprising:

a portion of the fluid line adapted to be interoperable with a pump actuator such that fluid may be conveyed therethrough;

a filter, or filter connectors to permit connection to a filter, to complete a closed fluid circuit joining said draw and return lines;

said pump actuator having a first configuration in which a positive pressure is generated in said return line and a second configuration in which a negative pressure in said return line, whereby a flow through said return line may be reversed when the pump actuator switches from the first configuration to the second configuration, and

a blood leak sensor coupled to said fluid line.

83. (Previously Presented) A detector line as in claim 82, wherein said pump actuator in the second configuration is further configured to reverse a flow in both said return line and said draw line.

84. (Previously Presented) A blood flow direction control device for a sterile contiguous fluid line for infusing a patient, the fluid line including a draw line

connectable to at least one patient access and a return line connectable to said at least one patient access, said device comprising:

a portion of the fluid line adapted to be interoperable with a pump actuator such that fluid may be conveyed therethrough;

a filter, or filter connectors to permit connection to a filter, to complete a closed fluid circuit joining said draw and return lines;

at least a wetted portion of the portion of the fluid line and the pump actuator having a reverse flow operational mode in which the actuator generates a negative pressure in said fluid line, and a flow through said return line is reversed.

85. (Previously Presented) A blood flow direction device as in claim 84, wherein reverse a flow is achieved in both said return line and said draw line during the reverse flow operational mode.